EUROPEAN CENTRAL BANK

EUROSYSTEM

EURO AREA BALANCE OF PAYMENTS STATISTICS

THE SEASONAL ADJUSTMENT OF EURO AREA GOODS AND SERVICES: DIRECT VERSUS INDIRECT APPROACH

Last update: March 2010

Executive summary

The current methodology for the adjustment of seasonal and calendar effects applied to the euro area current account items in the euro area balance of payments statistics published by the ECB is based on a *direct approach*.[1] This means that the adjustment method is applied directly to the euro area aggregates, instead of adjusting the underlying country contributions and aggregating them afterwards.[2] This alternative procedure is referred to as the *indirect approach*. According to the "ESS Guidelines on Seasonal Adjustment",[3] there is no theoretical or empirical evidence that uniformly favours either of the aforementioned approaches. However, the two methodologies do not provide exactly the same results.

A set of comprehensive statistical quality criteria allow the performance of the results of direct adjustment to be compared with those of indirect adjustment. The criteria to be analysed are: (i) graphical analysis, (ii) study of the smoothness of the adjustments, (iii) analysis of the seasonal factors, (iv) the assessment of standard quality measures, (v) estimates of residual effects in the seasonally adjusted series and, finally, the analysis of stability using (vi) revision histories and (vii) sliding spans. Both adjustments are based on a multiplicative decomposition with X-12 ARIMA[4] applied to monthly time series from January 1999 to September 2009.

The document is organised into seven sections. Each section briefly introduces one of the quality criteria and includes, afterwards, an assessment on the measure based on the results of direct and indirect seasonal adjustment of euro area goods and services.

Table 1 summarises the results of the analysis performed on each quality measure. In most cases, the analysis does not indicate a clearly preferable method. In particular, the graphical analysis shows no

[1] Further information can be found in the document "Monthly seasonal adjustment of euro area balance of payments statistics", available at http://www.ecb.europa.eu/stats/pdf/sa_procedures.pdf?178372b0b7d7044149b193c38b947121

[2] The euro area balance of payments statistics are compiled by aggregating extra-euro area contributions received from all Members States belonging to the euro area and those of the ECB. A detailed description is available in the "Methodological notes", available at https://stats.ecb.int/stats/download/eas_ch07/eas_ch07/eas_note_ch7.pdf

[3] Available on the Eurostat website at http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-RA-09-006/EN/KS-RA-09-006-EN.PDF

significant differences between the directly and indirectly seasonally adjusted series for either goods or services. Even so, the analysis of monthly growth rates reveals that both the directly and the indirectly adjusted series occasionally move in opposite directions.

The results of roughness indicators show that the indirect method is preferable for both exports and imports of goods. However, there is no clear indication in favour of either method for services, as the two roughness measures used in this analysis give opposite messages. A comparison of the seasonal factors for the above-mentioned series does not show sizeable differences. However, these discrepancies may have a relevant impact on differences in the growth rates of seasonally adjusted series for consecutive months, in particular if they are concentrated around turning points.

The results of standard quality indicators for direct and indirect adjustments for goods and services do not differ significantly. The weighted averages of these indicators are very similar and prove a high level of seasonal adjustment quality overall. The most significant difference is for exports of goods, where the indirect method shows a high autocorrelation of the irregular component, but the direct method does not. In addition, application of the direct method to imports of goods shows higher, systematic fluctuations of the seasonal factors, particularly in recent years.

Furthermore, the quality of the seasonally adjusted data is also confirmed by the fact that there is no residual seasonality in the seasonally adjusted series. On the basis of the spectrum inspection, a trading day peak is still present in the indirect method for exports of goods and services. For that reason, it may be preferable to adjust these series using the direct method.

Revisions to the seasonally adjusted series when additional information becomes available are smaller if the direct approach is applied to exports of goods. Conversely, for imports of goods, the indirect method generates lower revisions. The direct approach is preferable for both credits and debits with respect to services.

Finally, a comparison of the two alternative seasonal estimates for the same set of observations over two different spans of data indicates that only in the case of imports of goods is there no clear evidence in favour of either method. In all other cases, the direct method produces more stable results.

Table 1: Summary of quality measures applied to seasonally adjusted data of goods and services

Quality measures	exports of goods	imports of goods	exports of services	imports of services
1. graphical analysis	-	-	-	-
2. smoothness	IND	IND	-	-
3. seasonal factors	-	-	-	-
4. seasonal adjustment quality indicators	-	-	-	-
5. residual effect in the seasonally adjusted series	DIR	-	DIR	-
6. stability analysis using revision histories	DIR	IND	DIR	DIR
7. stability analysis using sliding spans	DIR	-	DIR	DIR

Source: ECB.
Notes: DIR: in favour of the direct method, IND: in favour of the indirect method and "-": no clear preference for either method.

[4] The X-12-ARIMA method of seasonal adjustment was developed by the US Bureau of Census.

To conclude, the two alternative approaches were evaluated in order to verify whether there is still empirical support for the initial choice of the direct adjustment method for euro area exports and imports of goods and services as shown in the euro area balance of payments. The results of the quality measures obtained for the direct and indirect methods are not uniform, so that there is no clear evidence of superior performance by either of the two estimation methods. Against this empirical backdrop, it is preferable from a practical point of view to continue using the direct approach. This approach also entails less operational risk, in particular when a lack of identifiable seasonality makes it difficult to detect seasonal patterns in the series for individual countries.

1. Graphical analysis

Graphical analysis of the seasonally adjusted time series is essential to assess whether direct and indirect approaches lead to the similar results. In particular, this analysis makes it possible to verify the turning points of seasonally adjusted monthly growth rates and the directional reliability. Table 2 shows descriptive statistics of the discrepancies between the growth rates obtained using the direct and the indirect methods, and the directional reliability indicator (Q).

Table 2: Monthly growth rates: direct versus indirect approach:

(percentage points)

Series	Discrepancy between growth rates[1]			Q[2]
	Average	Standard deviation	Maximum	
Exports of goods	0.65	0.54	2.97	91%
Imports of goods	0.64	0.53	2.61	91%
Exports of services	0.92	0.75	3.88	87%
Imports of services	1.03	0.76	3.21	86%

1 Calculated from the absolute value of the difference.
2 Percentage of concordance between the directly and indirectly seasonally adjusted series (both either increase or decrease).

1.1. Exports and imports of goods

Charts 1 and 2 illustrate that, in general, there are no significant differences between the directly and indirectly derived series for exports and imports of goods. In the case of exports of goods, however, the most marked differences are concentrated mainly in the last three years, where a few months show discrepancies in excess of EUR 2 billion. As for the pattern of the seasonally adjusted series (see the trend-cycle in Chart 1), it is also important to mention that the differences between the direct and indirect estimation methods are higher around the turning points in the trend, as is the case with exports of goods from 2007 onwards.

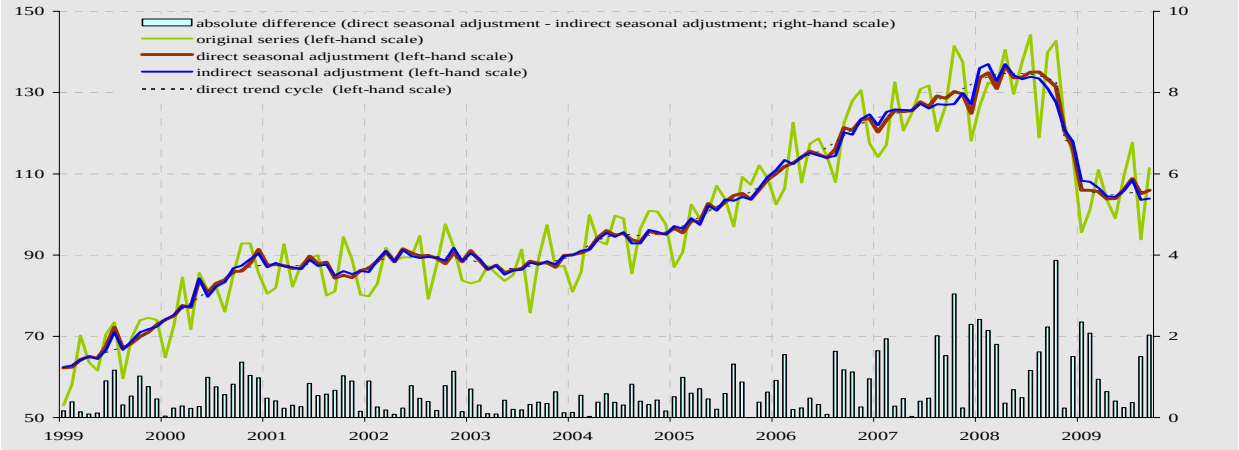
The divergence between monthly growth rates presented in Chart 1 in the Annex is assumed to be insignificant. In addition, the directional reliability indicator (Q) (see Table 2) shows 91% sign concordance in the case of both exports and imports of goods. The maximum difference between the rates is 2.97 percentage points and 2.61 percentage points for exports and imports of goods respectively, whereas the average of absolute discrepancies and the standard deviation are very similar for both series, equal to around 0.65 and 0.54 respectively.

The most marked monthly difference in the growth rate for exports was reported in November 2008. The discrepancy is due to the adjustment performed in October 2008, when a significant increase in exports of goods in the raw series was reported (see Chart 1). Both the direct and the indirect approach adjust the data downwards, but the indirect adjustment is remarkably stronger due to a noteworthy divergence in seasonal factors (see Chart 5 in the Annex). Hence, it has a sizable impact on the difference in monthly growth rates calculated for these two months.

In the case of imports of goods, the greatest difference between monthly growth rates was recorded in January 2001. The upward adjustment of the raw series (stronger for the direct approach) one month earlier and the noticeable decrease in seasonally adjusted data in January explain the substantial difference in the growth rates (see Chart 2 in the Annex).

Chart 1: Original, direct and indirect seasonally adjusted series - exports of goods

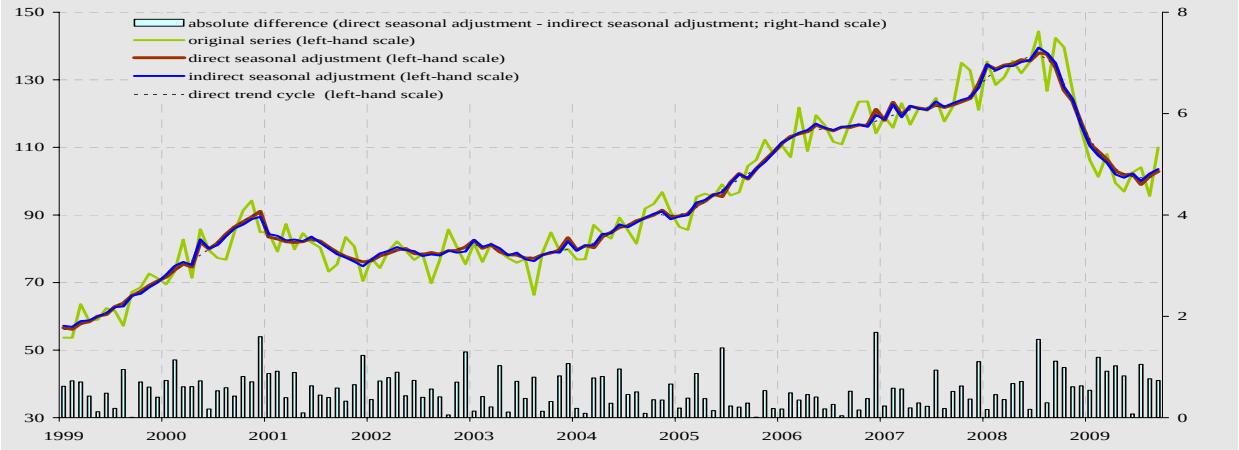
(EUR billions)



Source: ECB.

Chart 2: Original, direct and indirect seasonally adjusted series - imports of goods

(EUR billions)



Source: ECB.

1.2. Exports and imports of services

A preliminary comparison of the seasonal estimates for exports and imports of services reveals no visual differences between these two approaches (see Charts 3 and 4). Further inspection of the monthly growth rates depicted in Charts 3 and 4 in the Annex show that the discrepancies between the two methods considered are slightly greater for imports of services than for exports of services. For the latter, the average difference is equal to 0.92 percentage point, whereas for imports it is 1.03 percentage points.

The most marked discrepancy between the monthly growth rates calculated with the direct and indirect methods in the case of exports of services is visible in January 2002. For that observation, the raw data were adjusted upwards in the case of both methods and the divergence of seasonal factors was not

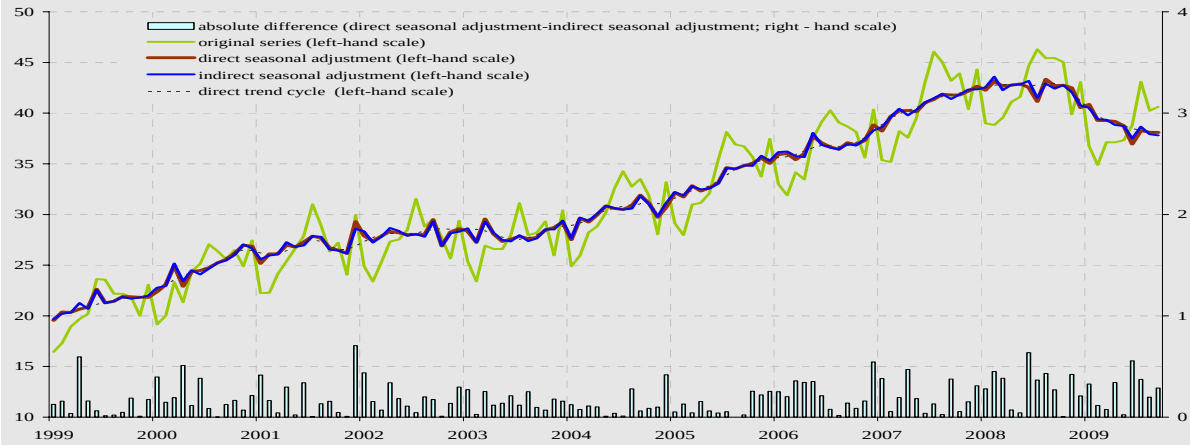
significantly different from that in other months (see Chart 7 in the Annex). However, considering the level of the seasonally adjusted data from the previous month, the value decreased more substantially with the direct approach than with the indirect approach.

As regards imports of services, the largest difference appears in March 2004, when the data adjusted with the direct method is adjusted downwards, whereas data adjusted with the indirect method is adjusted upwards. Consequently, for this observation, the difference between the monthly growth rates is significant.

With respect to the directional reliability indicator, the number of observations for exports and imports of services that move in the same direction is similar (87% and 86% respectively).

Chart 3: Original, direct and indirect seasonally adjusted series - exports of services

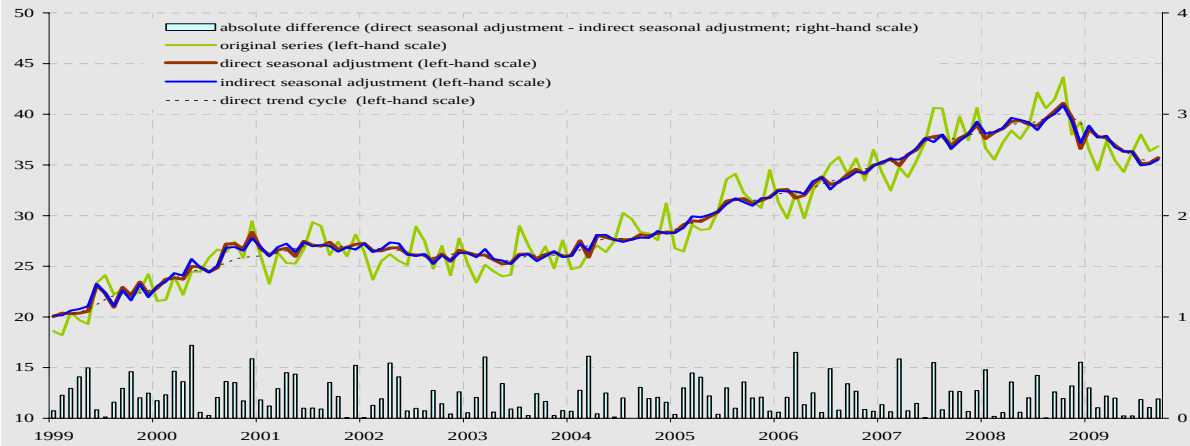
(EUR billions)



Source: ECB.

Chart 4: Original, direct and indirect seasonally adjusted series - imports of services

(EUR billions)



Source: ECB.

2. Analysis of smoothness

There are two measures of the roughness of seasonally adjusted aggregates proposed by Dagum[5] that describe how the seasonally adjusted series differ from a smooth trend. The first, (R_1), is defined by the following equation:

$$R_1 = \frac{1}{N-1}\sum_{t=2}^{N}(A_t - A_{t-1})^2,$$

where A_t is the adjusted series, N is the length of the series and $\{t : 1 \le t \le N\}$.

As far as the second measure (R_2) is concerned, it involves the 13-term Henderson filter (H_{13})[6]. The seasonally adjusted series is smoothed with this filter. R_2 is defined as follows:

$$R_2 = \frac{1}{N-1}\sum_{t=1}^{N}(A_t - H_{13}A_t)^2.$$

In Table 3, percentage change values show the improvement in the smoothness of the seasonally adjusted series when going from direct to indirect seasonal adjustment. A positive sign indicates that the result of indirect adjustment is smoother than that of the direct one.

Table 3: Measures of roughness for seasonally adjusted series, direct versus indirect approach

Series	Measures	Direct		Indirect		Percentage change	
		Full series	Last 3 years	Full series	Last 3 years	Full series	Last 3 years
Exports of goods	R1	2654	3731	2488	3301	6%	12%
	R2	0.069	0.091	0.015	0.015	78%	84%
Imports of goods	R1	2318	3132	2328	3204	0%	-2%
	R2	0.039	0.012	0.014	0.016	65%	-41%
Exports of services	R1	933	879	895	770	4%	12%
	R2	0.020	0.012	0.031	0.012	-58%	-3%
Imports of services	R1	833	929	797	892	4%	4%
	R2	0.021	0.016	0.029	0.018	-37%	-16%

Source: ECB.
Note: Square roots are applied to nominal R_1 and R_2 values.

2.1. Exports and imports of goods

For exports of goods, according to the statistics R_1 and R_2, there is a notable indication in favour of the indirect method. Positive percentage changes of these measures mean that the results of the indirect adjustment are smoother than those of the direct approach. The difference is substantially bigger for the last three years (see Table 3). For imports of goods, the R_2 indicator that measures the smoothness of the series against its trend shows a preference for the indirect method; however, based only on the analysis

[5] See E.B. Dagum, "On the seasonal adjustment of economic time series aggregates: A case study of the unemployment rate", National Commission on Employment and Unemployment Statistics, No 31, 1979,".

[6] The Henderson filter is derived by minimising the sum of squares of the third difference of the moving average series.

of the last three years, the results provided by the two indicators of roughness are in favour of the direct approach.

2.2. Exports and imports of services

The indirect method used for both exports and imports of services is smoother overall than the direct approach, according to the R_1 statistic that reflects the month-on-month changes in the seasonally adjusted series. However, R_2, which measures deviations of the seasonally adjusted series from the trend, provides the opposite message, indicating that the direct adjustment is smoother than the indirect one. Therefore, no clear preference can be given to either of method.

3. Analysis of seasonal factors

Seasonal factors are crucial to analysing the development of seasonally adjusted series. The first step in estimating these factors is to calculate detrended series (SI ratios) and replace detected extreme values of SI ratios. The next step includes estimation of the final seasonal factors with appropriate seasonal filters. The moving average filters can be selected automatically or specified separately for each month. In the case of the indirect method, the final seasonal filter is a linear combination of the filters used at the country level, where a 3x5 moving average is applied.

3.1. Exports and imports of goods

In the direct approach, the filter (3x9 moving average) was selected for all the months except January, July, September, October and December, where a shorter seasonal filter (3x1) was used in order to better estimate seasonal movements in the variable. Chart 5 in the Annex presents the final seasonal factors estimated for the direct and indirect approach. In general, there are no significant differences in the factors estimated for any month using either method. The most noteworthy are for the months of January, February, October and December in the last four years. These differences may arise because different seasonal filters are used for the two alternative methods.

In the direct method, seasonal factors for imports of goods are estimated by applying the same seasonal filters to every month (3x5 moving average). Chart 6 in the Annex presents the monthly seasonal factors for both the direct and the indirect estimation methods. Overall, there are no sizable differences between the factors.

3.2. Exports and imports of services

In the direct approach, the same seasonal filters were used for exports and imports of services in every month (3x5 moving average). For exports of services, the most marked differences are in April and October of the first two years (see Chart 7 in the Annex). In the indirect approach, seasonal factors for

December change much more than for any other month. In the case of imports of services, the most sizeable discrepancies between the factors are in March and April, as presented in Chart 8 in the Annex.

4. Quality indicators of seasonal adjustment

The performance of these two approaches can also be assessed on the basis of a set of standard quality measures. These include eleven *M* statistics, together with *Q*, which is the weighted average of the *M* statistics (see Table 4). Values between zero and one belong to the acceptance region. Higher values may indicate a problem in the estimation of the seasonally adjusted series.[7] The detailed description of each indicator is presented in Table 4. Although small differences between the values employed in the direct and indirect approaches cannot be used to determine which method is superior, some unaccepted values in the statistics help to identify possible complications in the seasonally adjusted series.

4.1. Exports and imports of goods

For exports of goods, all measures calculated for both direct and indirect methods except for one (M4 for the indirect approach) lie in the acceptance interval. The relatively high value of the M4 indicator reflects the amount of autocorrelation in the irregular component and may indicate a need for trading day regressor. As the trading-day adjustment is already incorporated into the estimate, another possible reason for the relatively high autocorrelation is the sampling design. In general, this measure moves quite independently from the others and does not reveal a problem with the overall quality of the seasonal adjustment. In fact, it has a minimal weight in the *Q* indicator, as can be observed in Table 4, where the *Q* indicator values of both adjustments for exports of goods are quite similar.

Regarding imports of goods, all measures of the quality indicators are acceptable for both methods, with the exception of the M8, M10 and M11 measures. These values indicate, in particular for recent years, significant and systematic fluctuations in the seasonal component. This implies that the seasonal factor estimates will be distorted by the end-weights of the seasonal filters. Overall, the weighted average of the indicators for both methods applied to exports and imports of goods are very similar; therefore, they do not lead to significantly different results.

4.2. Exports and imports of services

All values of *M* statistics for exports and imports of services estimated using both methods are acceptable. In particular, the weights of the irregular components are only slightly better with respect to the direct estimations; therefore, this is not the case where the irregularities have a greater impact on the indirect approach and make it more difficult to estimate seasonal patterns. The weighted averages of the

[7] See J. Lothian and M. Morry, "A set of quality control statistics for the X-11-Arima seasonal adjustment method", 1978.

quality measures are similar. Consequently, there is no evidence that one method performs better than the other.

Table 4: Direct versus indirect approach: seasonal adjustment of quality indicators

Seasonal adjustment quality indicators		Time series							
		exports of goods		imports of goods		exports of services		imports of services	
		direct	indirect	direct	indirect	direct	indirect	direct	indirect
Relative contribution of the irregular component over a three-month span	**M1**	0.2	0.2	0.1	0.3	0.2	0.2	0.3	0.4
Relative contribution of the irregular component to the stationary portion of the variance	**M2**	0.1	0.1	0.0	0.1	0.2	0.1	0.2	0.2
Amount of month-to-month change in the irregular component as compared with the amount of month to month change in the trend-cycle	**M3**	0.2	0.2	0.0	0.0	0.3	0.5	0.4	0.7
Amount of autocorrelation in the irregular component as described by the average duration of run	**M4**	0.4	**1.0**	0.5	0.5	0.1	0.2	0.1	0.3
Number of months it takes the change in the trend-cycle to surpass the amount of change in the irregular component	**M5**	0.3	0.3	0.0	0.1	0.3	0.5	0.4	0.5
Amount of year-to-year change in the irregular component as compared to the amount of year-to-year change in the seasonal component	**M6**	0.0	0.9	0.8	0.5	0.0	0.8	0.2	0.7
Amount of moving seasonality present relative to the amount of stable seasonality	**M7**	0.2	0.4	0.3	0.5	0.2	0.2	0.2	0.3
Size of the fluctuations in the seasonal component throughout the whole series	**M8**	0.4	0.4	**1.0**	0.6	0.3	0.6	0.4	0.6
Average linear movement in the seasonal component throughout the whole series	**M9**	0.3	0.3	0.8	0.5	0.2	0.3	0.3	0.2
Same as 8, calculated for recent years only	**M10**	0.4	0.5	**1.3**	0.9	0.3	0.5	0.6	0.6
Same as 9, calculated for recent years only	**M11**	0.4	0.5	**1.2**	0.9	0.3	0.4	0.6	0.5
Q weighted average of M indicators	**Q**	**0.3**	**0.4**	**0.4**	**0.4**	**0.2**	**0.4**	**0.3**	**0.5**

Source: ECB.

5. Residual effect in the seasonally adjusted series

In order to ensure that the seasonality in the time series has been appropriately detected, it is important to check if any significant residual seasonality or calendar effect is still present in the seasonally adjusted series. In the direct approach, residual seasonality can result from an inadequate adjustment procedure. For the indirect method, residual seasonality and/or trading day effects can still be present if the seasonality in the country contributions is difficult to detect or improperly estimated. The results of the spectrum inspection of the residual effects are reported in Table 5.

Table 5: Spectrum analysis for seasonally adjusted series

Series	Residual effect	SA series	
		Direct	Indirect
Exports of goods	Seasonality	NO	NO
	Trading day	NO	YES
Imports of goods	Seasonality	NO	NO
	Trading day	NO	NO
Exports of services	Seasonality	NO	NO
	Trading day	NO	YES
Imports of services	Seasonality	NO	NO
	Trading day	NO	NO

Source: ECB.

Note: The spectrum estimated for the seasonally adjusted series is modified for the extreme values.

5.1. Exports and imports of goods

No residual seasonality remains in the directly or indirectly seasonally adjusted series for either exports or imports of goods, which also confirms the good quality of this seasonal adjustment. For exports of goods, however, the results of the indirect estimate indicate that a trading-day effect remains in the adjusted data, despite the working-day adjustment applied individually to each euro area country.

5.2. Exports and imports of services

Based on the spectrum analysis, no residual seasonality is apparent in the indirectly seasonally adjusted series for either exports or imports of services. However, for the exports of services, the spectrum shows that a trading-day effect remains in the indirectly seasonally adjusted data, despite the working-day adjustment applied individually to each euro area country.

6. Analysis of stability using revision histories

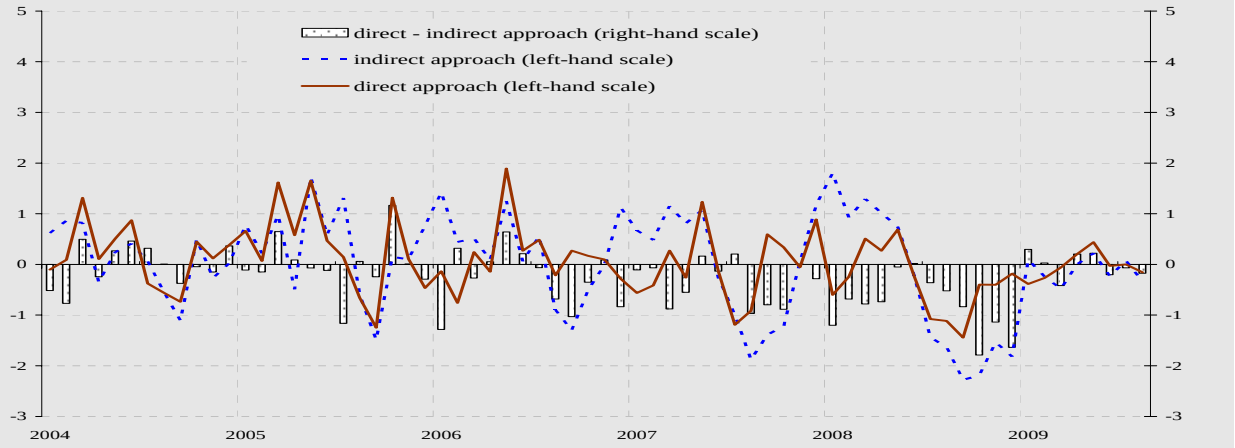
The analysis of stability here refers to the size of revisions that occur when additional observations in the raw time series become available. In order to obtain only the revision effect of seasonal factors, all remaining parameters of the model are frozen. One of the stability diagnostics of X12-ARIMA – revision histories – considers the revisions associated with continuous seasonal adjustment over a period of years. This analysis is applied to the last six years of the series (January 2004 to August 2009). The revisions depicted in Charts 5 to 8 are calculated as a percentage difference of the earliest adjustment of the observation obtained when that month is the final month in the series, and the later adjustment is based on all the observations available at the time of the analysis. The bar graphs show the differences between the revisions obtained with the two methods: $abs[R_{direct}] - abs[R_{indirect}]$. The negative values indicate larger revisions for the indirect approach.

6.1. Exports and imports of goods

The results for exports of goods indicate a better performance of the direct method (see Chart 5). For imports of goods, the comparison of the concurrent versus the final adjustment presented in Chart 6 indicates that the indirect method performed slightly better, even though in most cases the absolute discrepancies in percentage revisions between the two methods were rather small (around 1 percentage point).

Chart 5: Percentage revisions of concurrent versus final direct and indirect seasonal adjustment values, and differences between the two approaches – exports of goods

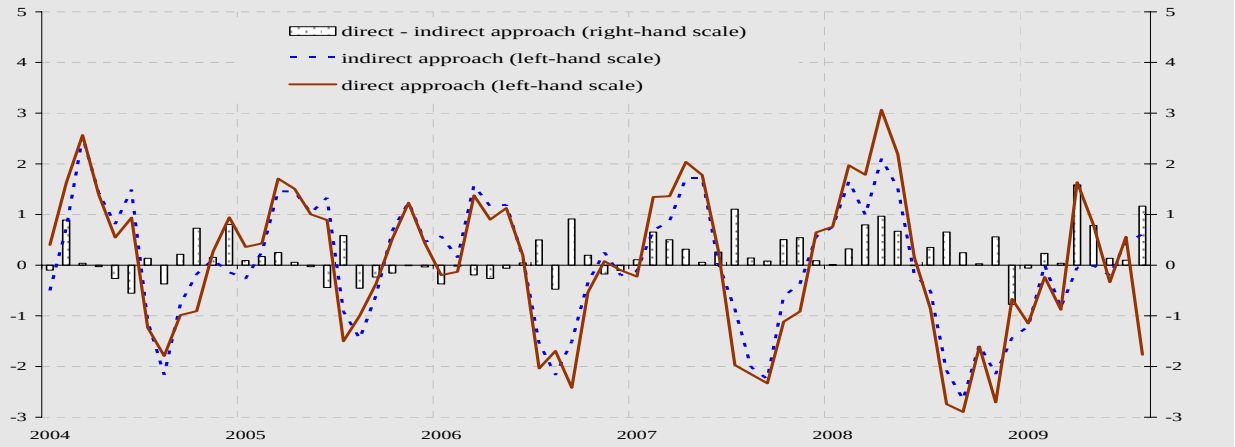
(percentage points (right-hand scale); percentages (left-hand scale))



Source: ECB.

Chart 6: Percentage revisions of concurrent versus final direct and indirect seasonal adjustment values, and differences between the two approaches – imports of goods

(percentage points (right-hand scale); percentages (left-hand scale))



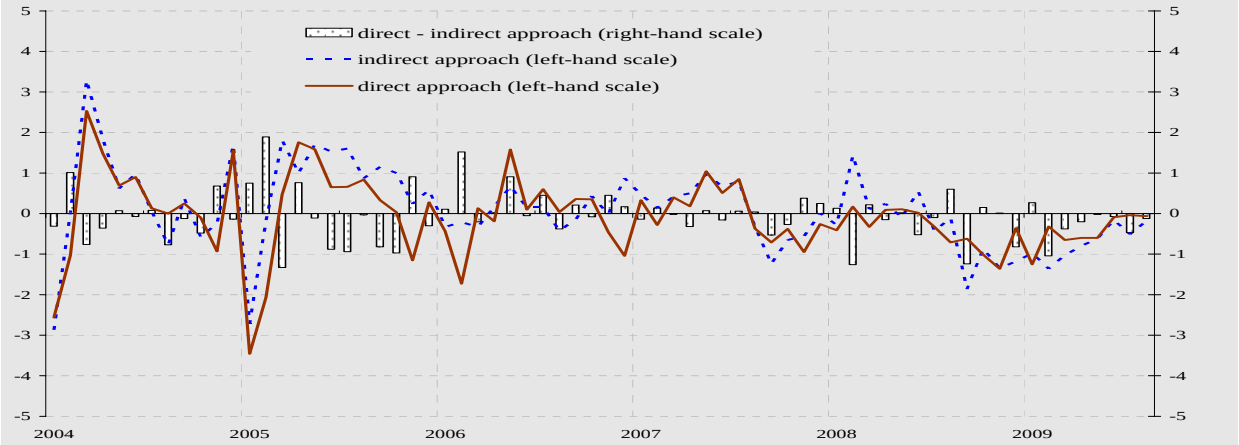
Source: ECB.

6.2. Exports and imports of services

The comparison between the concurrent and final adjustment of exports of services obtained with the two methods indicates that the direct adjustment performed slightly better than the indirect adjustment (see Chart 7). A similar result is obtained for the imports of services, as presented in Chart 8.

Chart 7: Percentage revisions of concurrent versus final direct and indirect seasonal adjustment values, and differences between the two approaches – exports of services

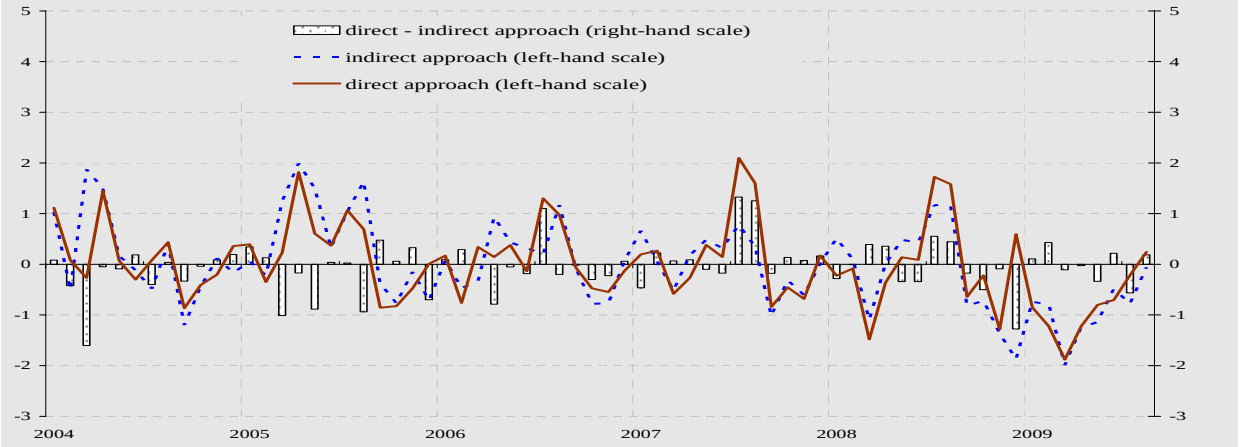
(percentage points (right-hand scale); percentages (left-hand scale))



Source: ECB.

Chart 8: Percentage revisions of concurrent versus final direct and indirect seasonal adjustment values, and differences between the two approaches – imports of services

(percentage points (right-hand scale); percentages (left-hand scale))



Source: ECB.

7. Analysis of stability using sliding spans

Another method for assessing the relative performance of the direct and indirect approaches in terms of the stability of the outcome is the sliding-spans diagnosis. This procedure analyses two time spans of the same length. The first span covers the period from November 1999 to September 2008, whereas the second span starts one year later and ends with the last time reference in the series (November 2000 to September 2009). The analysis focuses on a comparison of the seasonal factors and the month-on-month changes in the seasonally adjusted series for all the observations included in both spans.

Table 6 summarises descriptive statistics of the differences between the two spans. If the discrepancies of seasonal factors and month-on-month changes are larger than a fixed threshold set at 2 percentage points, and/or estimates across the spans have opposite signs, they are identified as inconsistent.

Table 6 Direct versus indirect approach – differences across sliding spans

(percentage points)

		exports of goods		imports of goods		exports of services		imports of services	
		direct	indirect	direct	indirect	direct	indirect	direct	indirect
Max percent differences across spans	**Seasonal factors** (Nov2000-Sep2008)								
	Median	0.23	0.35	0.35	0.35	0.34	0.37	0.24	0.25
	Max	1.41	2.01	2.84	2.68	1.39	2.49	1.3	2.13
	Standard deviation	0.24	0.42	0.58	0.49	0.30	0.47	0.25	0.43
	Inconsistent estimates	0 out of 95 [0%]	6 out of 95 [6%]	6 out of 95 [6%]	3 out of 95 [3%]	0 out of 95 [0%]	2 out of 95 [2%]	0 out of 95 [0%]	1 out of 95 [1%]
Max percent differences across spans	**Month-to-month changes in SA series** (Dec2000-Sep2008)								
	Median	0.30	0.27	0.29	0.38	0.39	0.51	0.30	0.39
	Max	1.25	1.58	2.78	1.41	1.94	3.11	1.71	3.35
	Standard deviation	0.29	0.34	0.48	0.36	0.42	0.70	0.38	0.59
	Inconsistent estimates	9 out of 94 [10%]	13 out of 94 [14%]	12 out of 94 [13%]	7 out of 94 [7%]	6 out of 94 [6%]	17 out of 94 [18%]	9 out of 94 [10%]	8 out of 94 [9%]

Source: ECB.

7.1. Exports and imports of goods

The differences in the seasonal factors for the indirect method of exports of goods are larger and more variable than for the direct method (see Table 6). In addition, 6% of the observations for the indirect approach are defined as inconsistent, whereas for the direct method there is no such case (see also Chart 9). As for the monthly percentage changes calculated on the exports of goods, there are no significant identifiable differences between the two approaches (see Chart 10).

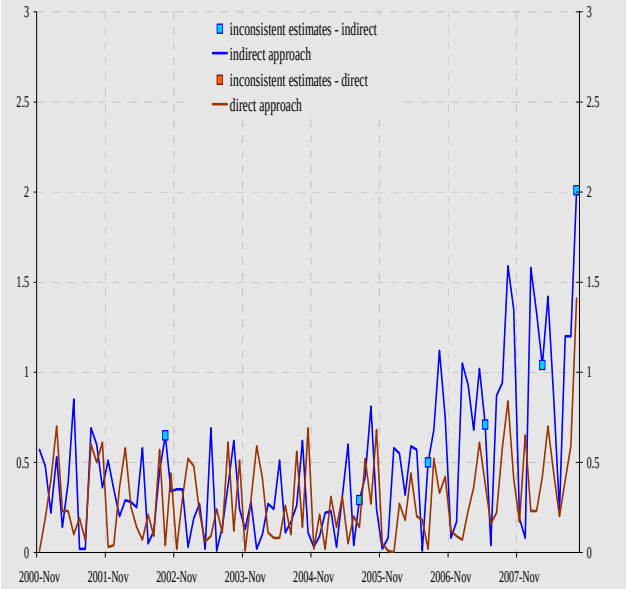
In the case of imports of goods, the discrepancies between seasonal factors across the spans have the same median. Lower volatility and fewer inconsistent observations favour the indirect method. The opposite is true for month-on-month changes in seasonally adjusted data, and the direct method is preferable due to the lower average. However, as shown in Chart 12, the differences become noteworthy in the last two years.

7.2. Exports and imports of services

As shown in the Table 6, in the case of exports of services, the direct method performs better in terms of the number of inconsistent estimates of seasonal factors and monthly growth rates across the spans. It also gives more stable results in both cases (see Charts 13 and 14). In the case of imports of services, the discrepancies between the spans are somewhat also smaller for the direct approach, as presented in the Charts 15 and 16.

Chart 9: Differences between seasonal factors across spans and inconsistent estimates for direct and indirect seasonal adjustment – exports of goods

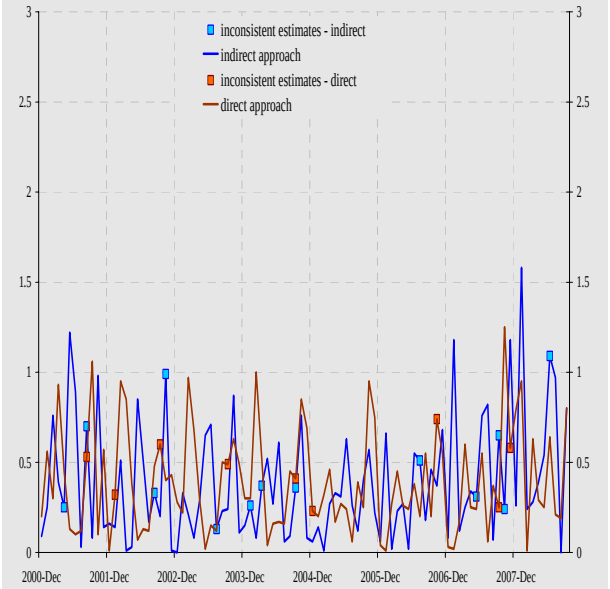
(percentages)



Source: ECB.

Chart 10: Differences between month-on-month changes across spans and inconsistent estimates for direct and indirect seasonal adjustment – exports of goods

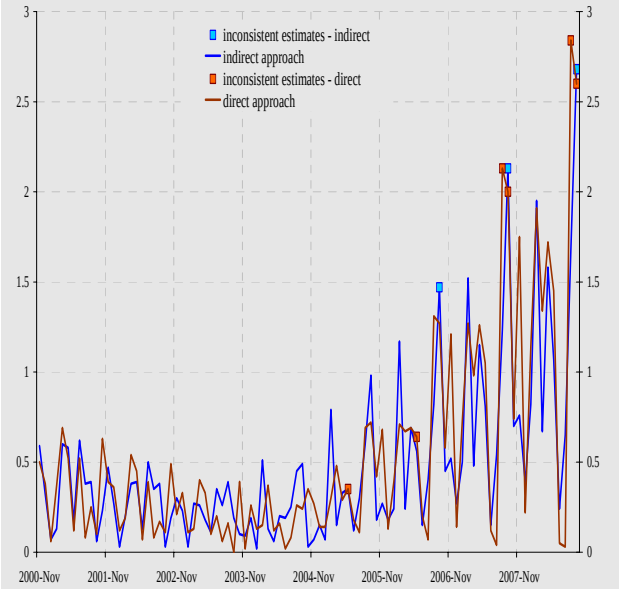
(percentages)



Source: ECB.

Chart 11: Differences between seasonal factors across spans and inconsistent estimates for direct and indirect seasonal adjustment – imports of goods

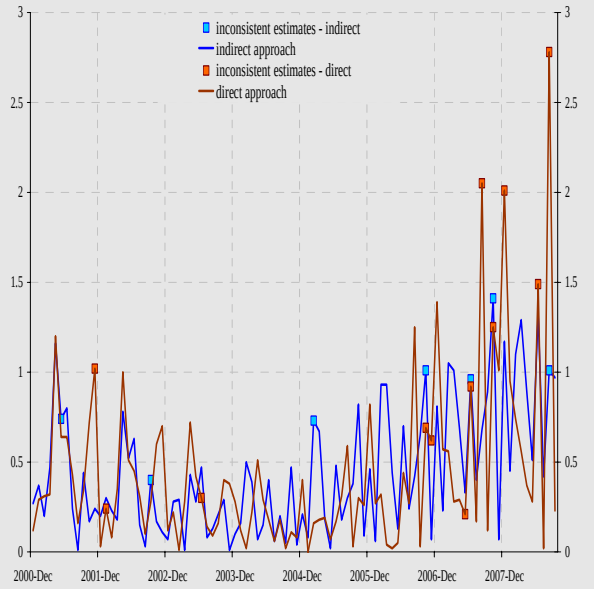
(percentages)



Source: ECB.

Chart 12: Differences between month-on-month changes across spans and inconsistent estimates for direct and indirect seasonal adjustment – imports of goods

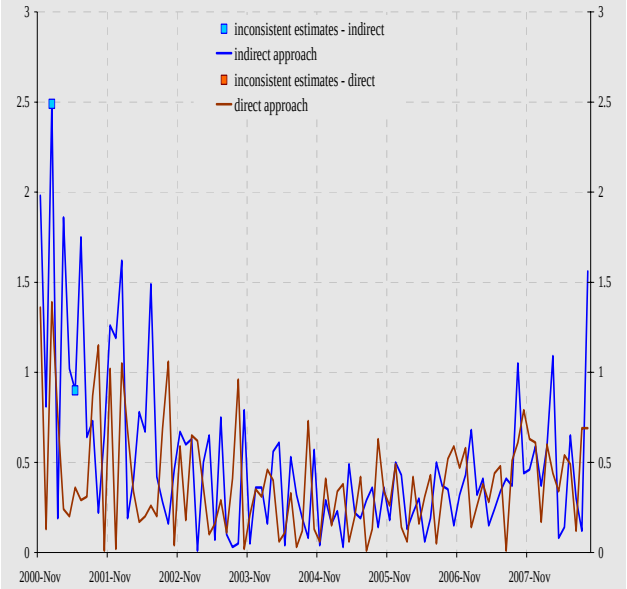
(percentages)



Source: ECB.

Chart 13: Differences between seasonal factors across spans and inconsistent estimates for direct and indirect seasonal adjustment – exports of services

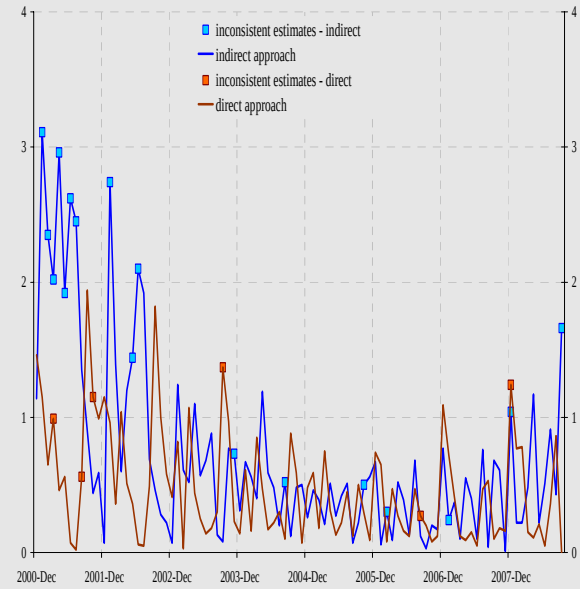
(percentages)



Source: ECB.

Chart 14: Differences between month-on-month changes across spans and inconsistent estimates for direct and indirect seasonal adjustment – exports of services

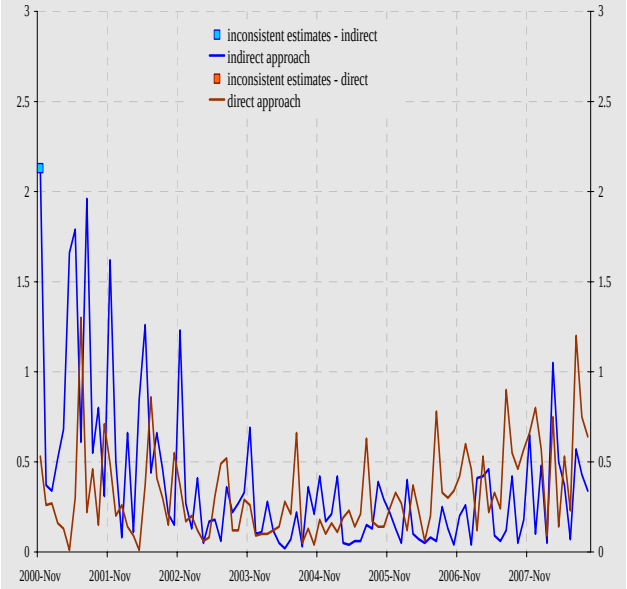
(percentages)



Source: ECB.

Chart 15: Differences between seasonal factors across spans and inconsistent estimates for direct and indirect seasonal adjustment – imports of services

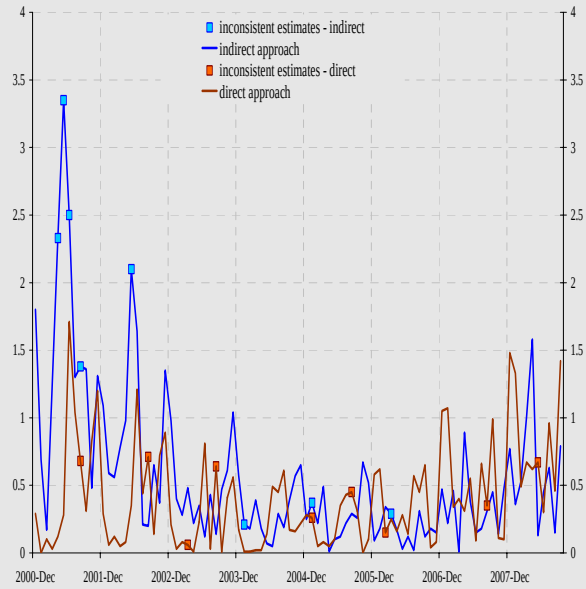
(percentages)



Source: ECB.

Chart 16: Differences between month-on-month changes across spans and inconsistent estimates for direct and indirect seasonal adjustment – imports of services

(percentages)

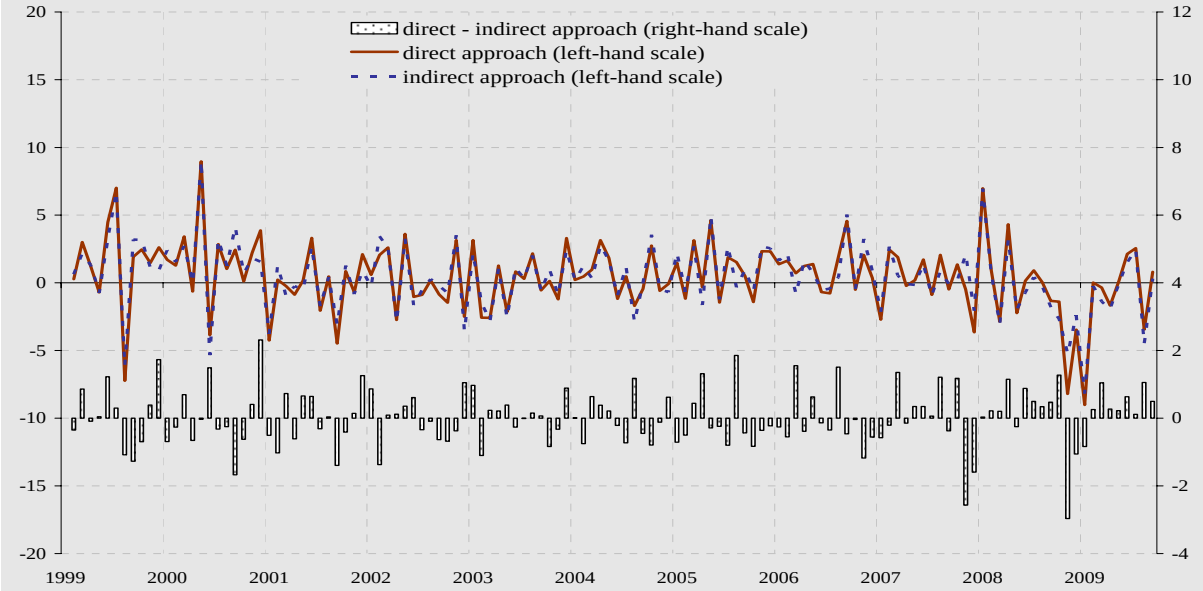


Source: ECB.

ANNEX

Chart 1: Month-on-month growth rates of seasonally adjusted series obtained with direct and indirect approaches, and differences in the growth rates – exports of goods

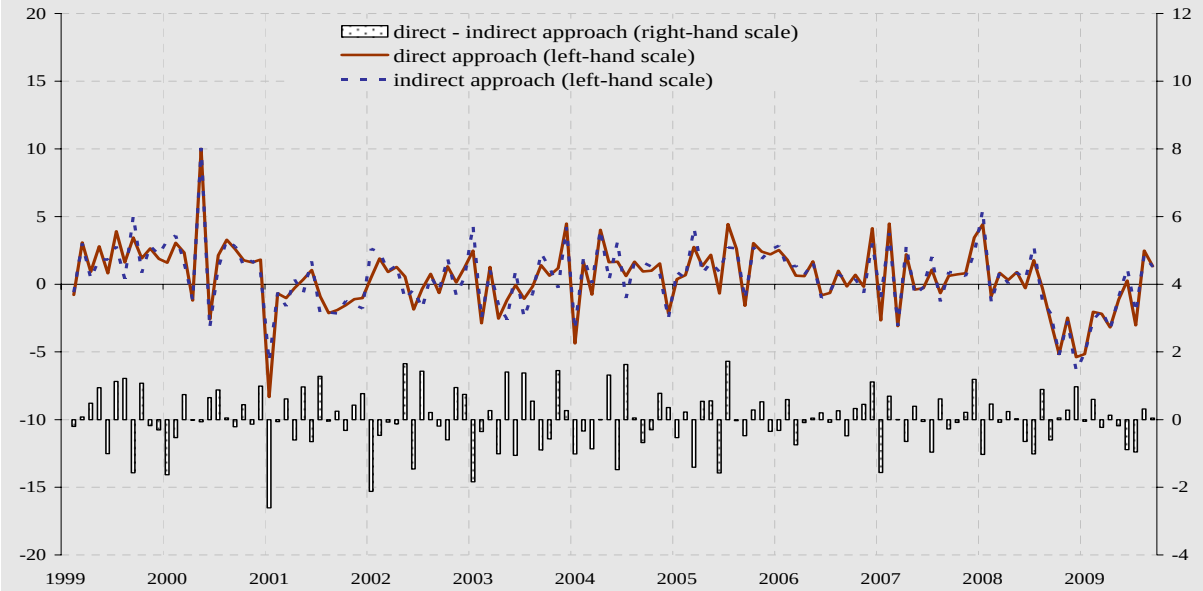
(percentage points (right-hand scale) ; percentages (left-hand scale))



Source: ECB.

Chart 2: Month-on-month growth rates of seasonally adjusted series obtained with direct and indirect approaches, and differences in the growth rates – imports of goods

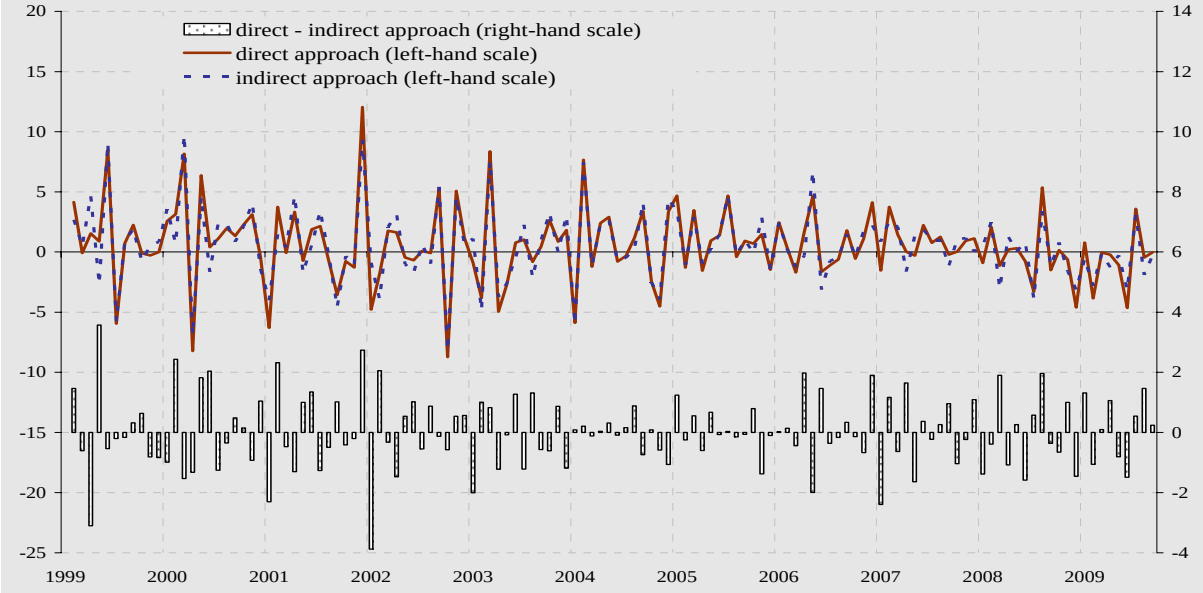
(percentage points (right-hand scale) ; percentages (left-hand scale))



Source: ECB.

Chart 3: Month-on-month growth rates of seasonally adjusted series obtained with direct and indirect approaches, and differences in the growth rates – exports of services

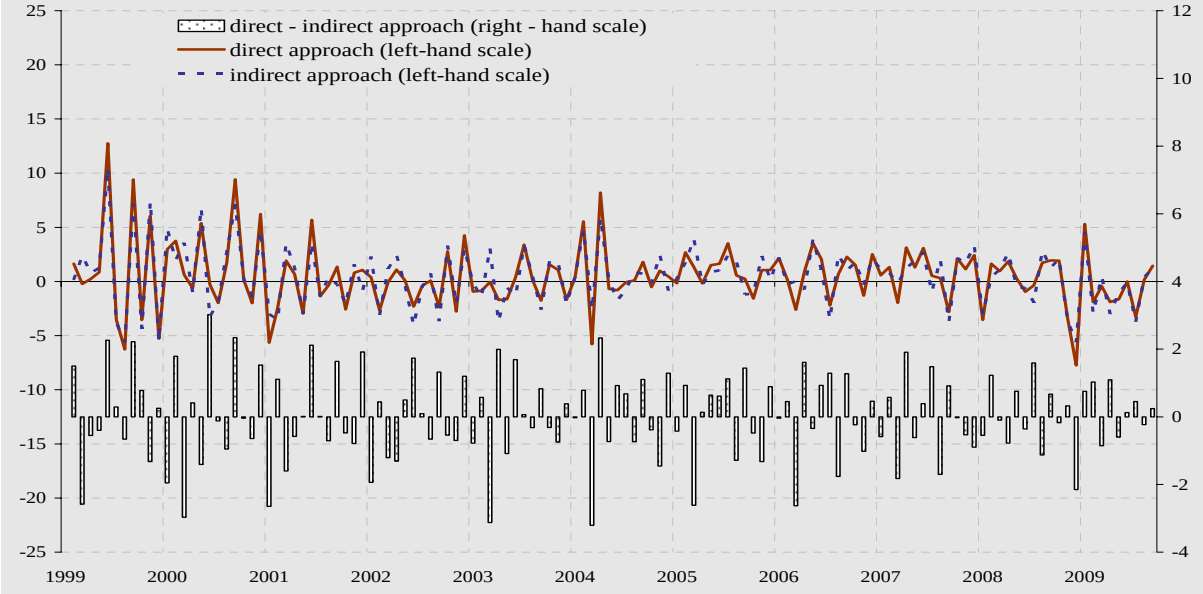
(percentage points (right-hand scale) ; percentages (left-hand scale))



Source: ECB.

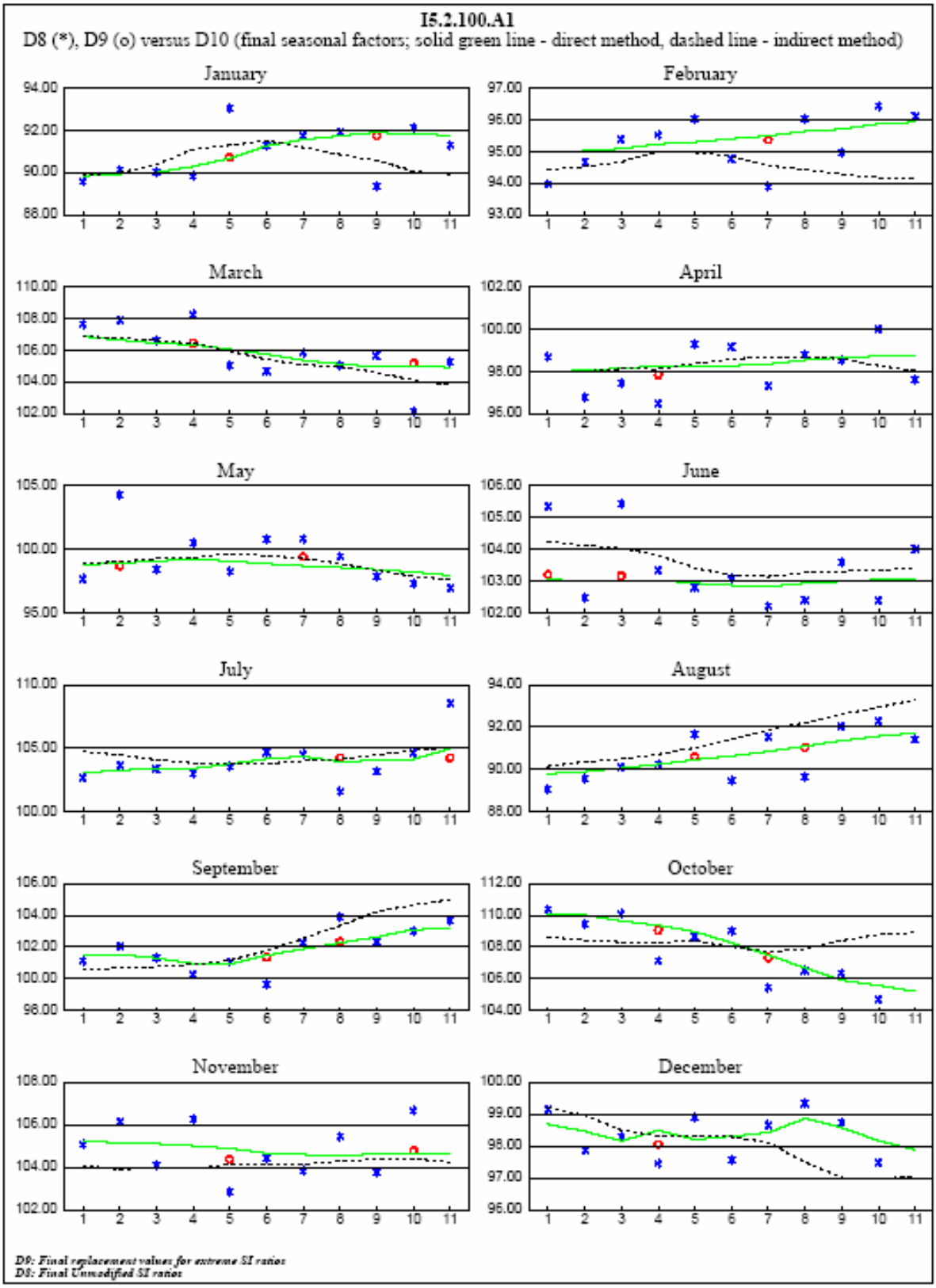
Chart 4: Month-on-month growth rates of seasonally adjusted series obtained with direct and indirect approaches, and differences in the growth rates – imports of services

(percentage points (right-hand scale) ; percentages (left-hand scale))



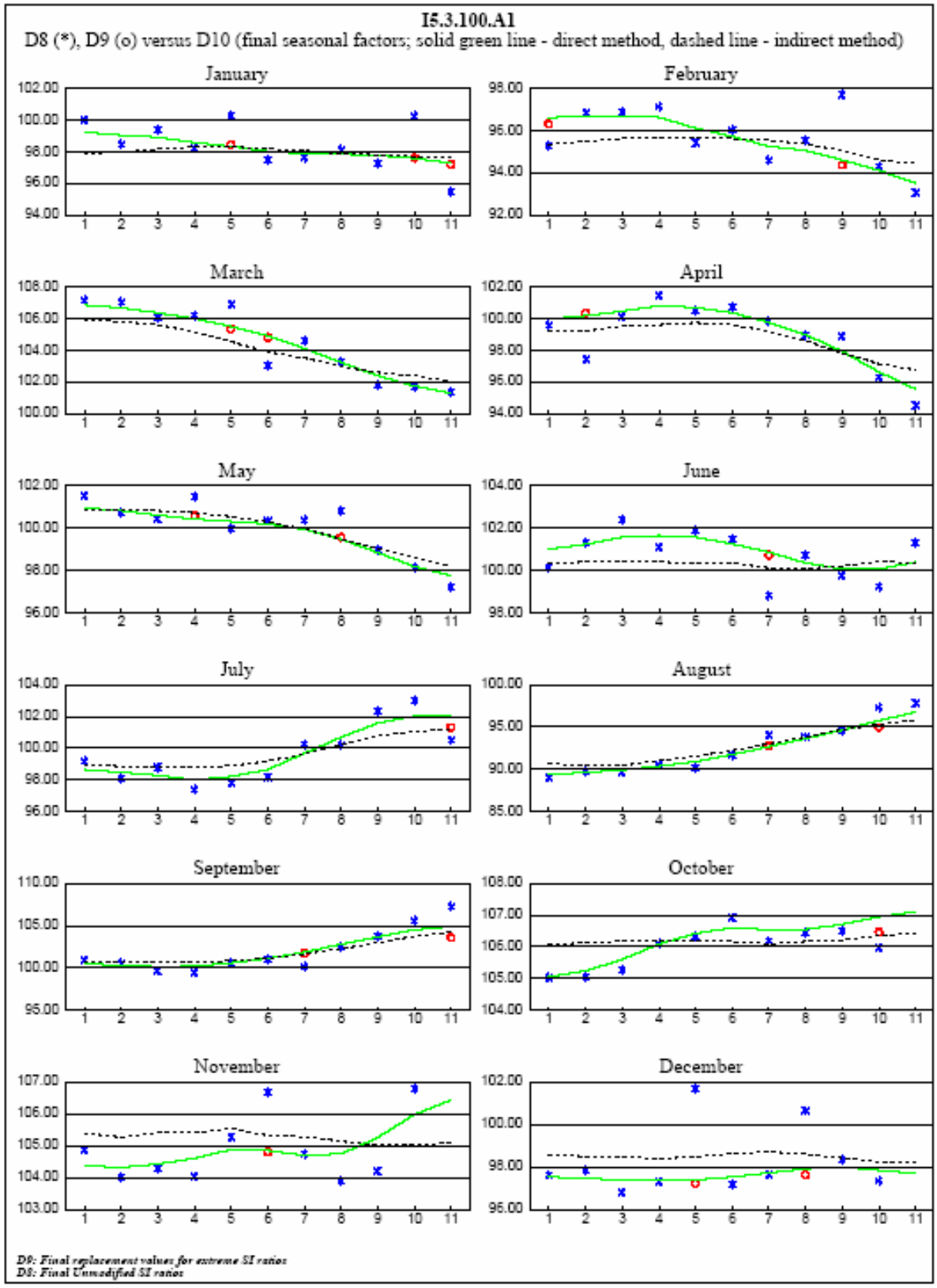
Source: ECB.

Chart 5 : Final seasonal factors for each month, direct versus indirect approach – exports of goods



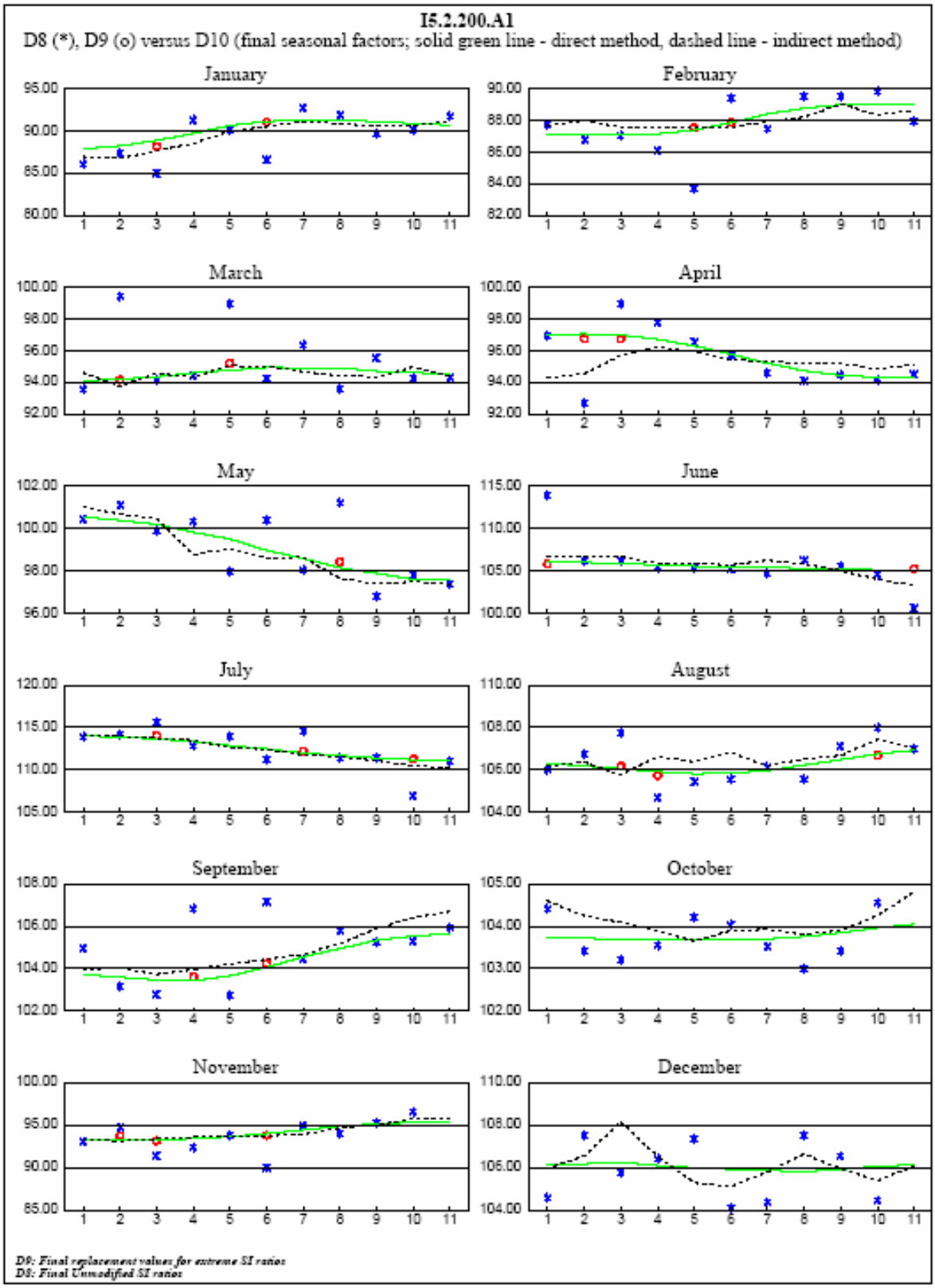
Source: ECB.

Chart 6: Final seasonal factors for each month, direct versus indirect approach – imports of goods



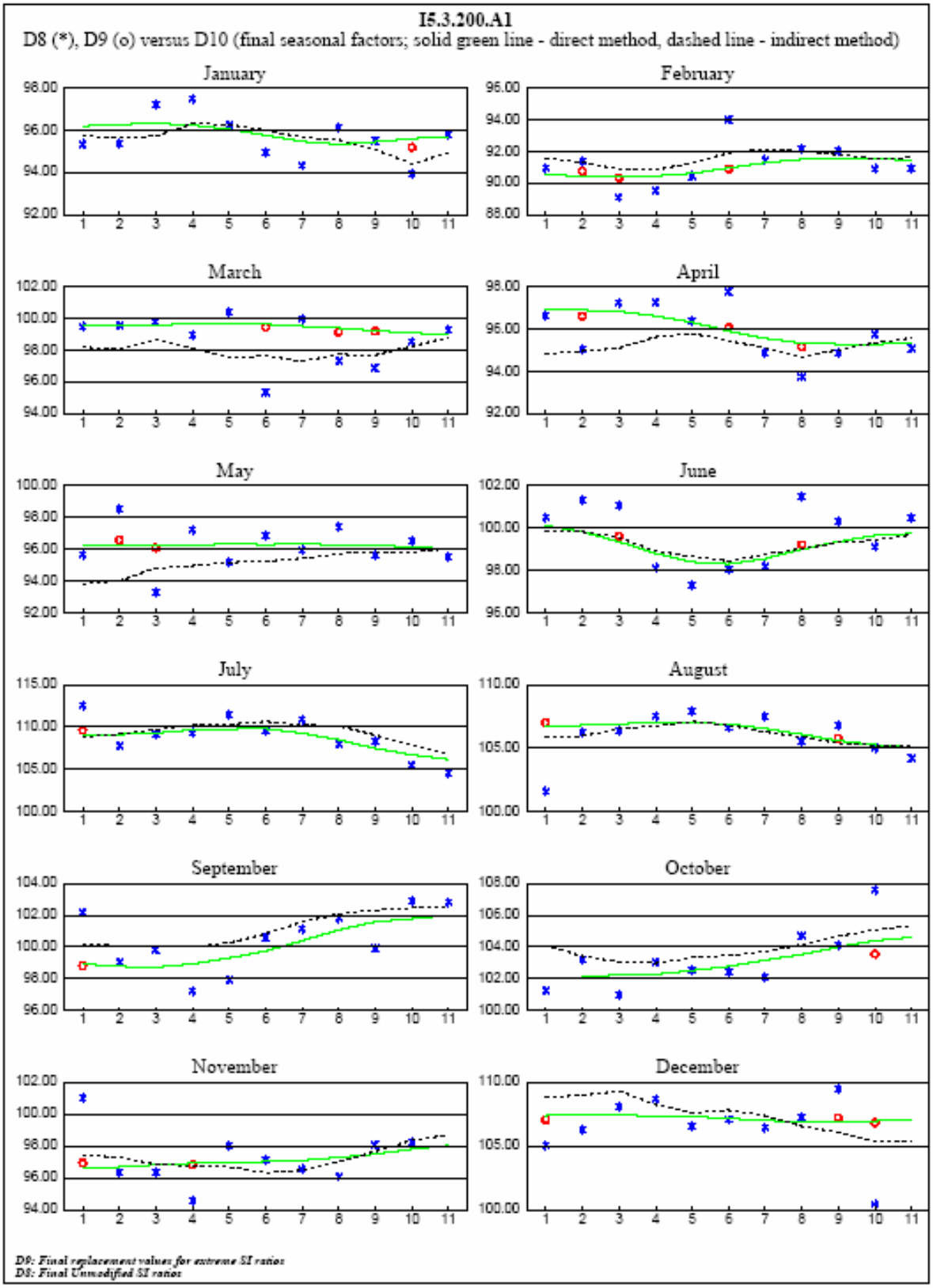
Source: ECB.

Chart 7: Final seasonal factors for each month, direct versus indirect approach – exports of services



Source: ECB.

Chart 8: Final seasonal factors for each month, direct versus indirect approach – imports of services



Source: ECB.